

CLAIMS

1. A flow control element comprising:
a tube-like wall section having a first end and a second end, the wall section defining a fluid flow channel extending from the first end to the second end of the wall section; and
a membrane connected to the wall section such that the membrane is disposed between the fluid flow channel and an external region located outside of the flow control element,
wherein the membrane defines a plurality of pinholes that are formed such that when the membrane is subjected to normal atmospheric conditions and the membrane remains undeformed, the plurality of pinholes remain closed to prevent fluid flow between the fluid flow channel and the external region through the membrane, and when the membrane is deformed in response to an applied pressure differential between the fluid flow channel and the external region, the plurality of pinholes open to facilitate fluid flow through the membrane.

2. The flow control element according to Claim 1,
wherein the wall section defines a central axis, and
wherein the membrane is substantially flat and arranged perpendicular to the central axis.

3. The flow control element according to Claim 1, wherein the plurality of pinholes are arranged in a two-dimensional pattern.

4. The flow control element according to Claim 1, wherein the wall section has a greater rigidity than the membrane such that, when an applied pressure differential is generated between the fluid flow channel and the external region, the membrane undergoes a greater deformation than the wall section.

5. The flow control element according to Claim 4, wherein the membrane and the wall section form an integrally molded structure comprising at least one of silicone, a thermoplastic elastomer, and soft rubber, and wherein the wall section has a first thickness that is greater than a second thickness of the membrane.

6. The flow control element according to Claim 4, wherein the wall section is formed from a first, relatively rigid material, and wherein the membrane is formed from a second, relatively elastic material.

7. The flow control element according to Claim 1, wherein the plurality of pinholes include a first pinhole and a second pinhole that are formed such that when the membrane is subjected to a first, relatively low applied pressure differential, the first pinhole remains closed and the second pinhole opens to facilitate a first, relatively low fluid flow rate through the membrane, and when the membrane is subjected to a second, relatively high applied pressure differential, both the first pinhole and the second pinhole open to facilitate a second, relatively high fluid flow rate through the membrane.

8. The flow control element according to Claim 1, wherein the flow control element comprises a nipple for a baby bottle.

9. The flow control element according to Claim 1, wherein the flow control element comprises a valve for a sippy cup.

10. A flow control element comprising:
a wall section surrounding a fluid flow channel; and

an elastic membrane connected to the wall section and extending across the fluid flow channel,

wherein the elastic membrane defines a plurality of first pinholes and a plurality of second pinholes,

wherein said pluralities of first pinholes and second pinholes are formed such that:

when the membrane is subjected to normal atmospheric conditions, both the first pinholes and the second pinholes remain closed to prevent fluid flow from the fluid flow channel through the membrane,

when the membrane is subjected to a first, relatively low applied pressure differential, the first pinholes remain closed and the second pinholes open to facilitate a first, relatively low fluid flow rate through the membrane, and

when the membrane is subjected to a second, relatively high applied pressure differential, both the first pinholes and the second pinholes open to facilitate a second, relatively high fluid flow rate through the membrane.

11. The flow control element according to Claim 10, wherein the wall section defines a central axis, and wherein the elastic membrane is substantially flat and arranged perpendicular to the central axis.

12. The flow control element according to Claim 10, wherein the first and second pinholes are arranged in a two-dimensional pattern.

13. The flow control element according to Claim 10, wherein the wall section has a greater rigidity than the elastic membrane such that, when an applied pressure differential is generated

between the fluid flow channel and an external region, the membrane undergoes a greater deformation than the wall section.

14. The flow control element according to Claim 13, wherein the membrane and the wall section form an integrally molded structure comprising at least one of silicone, a thermoplastic elastomer, and soft rubber, and wherein the wall section has a first thickness that is greater than a second thickness of the membrane.

15. The flow control element according to Claim 13, wherein the wall section is formed from a first, relatively rigid material, and wherein the membrane is formed from a second, relatively elastic material.

16. The flow control element according to Claim 10, wherein the flow control element comprises a nipple for a baby bottle.

17. The flow control element according to Claim 10, wherein the flow control element comprises a valve for a sippy cup.

18. A method for manufacturing a flow control element, the flow control element including a tube-like wall section surrounding a fluid flow channel, and an elastic membrane integrally formed with the wall section and extending across the fluid flow channel, the method comprising:

stretching the elastic membrane by applying a tensile force along the radial axis;

piercing the stretched elastic membrane using a plurality of pins, thereby forming a plurality of pinholes;
and

removing the first and second pins and releasing the tensile force, whereby each of the plurality of pinholes is closed by elastomeric material surrounding said each pinhole and the elastic membrane is subjected to normal atmospheric conditions.

19. The method according to Claim 18, wherein stretching comprises inserting a base structure into the wall section having a diameter that is 1% to 10% larger than a diameter of the wall section.

20. The method according to Claim 18, wherein piercing comprises inserting a first pin having a first diameter into the stretched elastic membrane to form a first pinhole, and inserting a second pin having a second diameter into the stretched elastic membrane to form a second pinhole, wherein the first diameter is smaller than the second diameter.